It is evident that it will be useful to find the approximate equation for heat capacities of gases available for a wider interval of temperatures. We present here a solution of this problem.

For this purpose let us take the expression

$$\alpha = C_p - C'_p \qquad (3)$$

where C_p is the exact molecular heat capacity and C'_p is that calculated by means of the equation of the Planck–Einstein type[4]

$$C'_p = C_{p_0} + \Sigma\varphi(\Theta_K/T) \qquad (4)$$

Our calculations have shown that α increases with the increase of temperature. In many cases this value is proportional to temperature T. We may approximate

$$\alpha = aT + bT^2 \qquad (5)$$

From equations (3), (4) and (5) it follows

$$C_p = C_{p_0} + \Sigma\varphi(\Theta_K/T) + aT + bT^2 \qquad (6)$$

This equation, as has been shown by our calculations, may be used for approximating heat capacities of gases calculated from spectroscopic data in a wide range of temperatures. The application of the equation (6) is not cumbersome, as good tables of the Planck–Einstein functions have been available and almost anyone can read off C_p in a few minutes. The applicability of the equation (6) was examined by us for nitrogen, carbon monoxide and sulfur. Using the data of Johnston and Davis[5] we have derived the following equations for nitrogen and carbon monoxide

$$N_2: \; C_p = 7/2R + \varphi(3360/T) + 0.40\cdot10^{-4}T \qquad (7)$$
$$CO: \; C_p = 7/2R + \varphi(3090/T) + 0.40\cdot10^{-4}T \qquad (8)$$

where φ represents Planck–Einstein function for two degrees of freedom. The coefficient b in both cases may be taken equal to zero.

The heat capacities calculated from these expressions agreed over the range of 50–5000°K. with an average deviation of ± less than 0.1% and with a maximum deviation of less than 0.3%.

In case of sulfur vapor, S_2, the application of the equation (6) gives the expression

$$C_p = 7/2R + \varphi(1042/T) + 0.60\cdot10^{-4}T \qquad (9)$$

the coefficients of which we have obtained from the spectroscopic calculations of Godnev and Sverdlin.[6] The value Θ is taken from our latter data.[7]

Equation (9) fits the theoretical molecular heat capacity curve in the interval 100–5000°K., with an average deviation of less than 0.1% and with a maximum deviation of 0.2%.

(4) Bryant, *Ind. Eng. Chem.*, **25**, 820 (1933).

(5) Johnston and Davis, THIS JOURNAL, **56**, 271 (1934).

(6) Godnev and Sverdlin, *J. Exp. Theoret. Physics* (U. S. S. R.), **5**, 864 (1935); *Z. Physik.*, **97**, 124 (1935).

(7) Godnev, *Phys. Z. Sow. Un.*, **7**, 442 (1935).

Summary

An equation is proposed for the approximate representation of the heat capacities of gases calculated from spectroscopic data

$$C_p = C_{p_0} + \Sigma\varphi(\Theta_K/T) + aT + bT^2$$

the applicability of which was examined for carbon monoxide, nitrogen and sulfur in the range 100–5000°K.

In these cases the approximation may be carried out very well with the coefficient b equal to the zero for the temperature interval 100–5000°K.

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2,6-Dimethylphenyl α-Naphthylcarbamate

BY CHARLES D. HURD AND M. A. POLLACK

Phenol and a xylenol were among the pyrolytic products of furfural.[1] Because of its melting point, 46°, the xylenol was thought to be 2,6-dimethylphenol. Its α-naphthyl isocyanate derivative melted at 174–175° but this was an unknown derivative at the time. In the present note this deficiency is supplied and the xylenol definitely confirmed as 2,6-dimethylphenol. 2,6-Dimethylphenyl α-naphthylcarbamate, synthesized from authentic 2,6-dimethylphenol. was found to melt at 176.5°.

Eastman 2,6 - dimethylphenol was used. It melted at 44° and underwent smooth bromination to yield 3,4,5-tribromo-2,6-dimethylphenol,[2] m. p. 201° (from petroleum ether).

One gram of the dimethylphenol and 1 g. of α-naphthyl isocyanate were mixed in a test-tube. When one drop of a solution of trimethylamine in dry ether was added, an exothermic reaction set in and the contents of the tube solidified. The solid was crystallized from petroleum ether; m. p. 176.5°. The melting point was unchanged by crystallizing from alcohol, but beautiful white flakes were formed thereby; yield, 1.7 g.

Anal. (By Howard Pollack). Calcd. for $C_{19}H_{17}O_2N$: C, 78.32; H, 5.88. Found: C, 78.47; H, 6.00.

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(1) Hurd, Goldsby and Osborne, THIS JOURNAL, **54**, 2536 (1932).

(2) Auwers and Markovits [*Ber.*, **41**, 2336 (1908)] record the m. p. of 200–201°.